

Rotating Opposed Fire Air (ROFA) and SNCR

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Summary

CP&L has aggressively pursued innovative NO_x reduction systems as part of our overall NO_x reduction strategy. This corporate strategy is to have a mix of cost effective NO_x reduction technologies to meet the NO_x targets for CP&L.

The Mobotec ROFA/Rotamix system, originally developed in Sweden, was recently demonstrated at the CP&L (Progress Energy) Cape Fear Plant. In 2000 a ROFA system (the first in the U.S. and the first on a pulverized coal fired boiler in the world) was installed on Cape Fear Unit 5, a 154 MWe CE 4 corner T-fired boiler constructed in the mid 1950's. The ROFA system utilizes a high velocity overfire air stream to provide staged combustion. The ROFA system reduced full load NO_x levels from 0.62 lb/MM Btu to 0.28 lb/MM Btu with minimal impacts on CO and LOI.

With the success of Cape Fear Unit 5, a combination ROFA/Rotamix system was installed on Cape Fear 6 in 2001. Unit 6 is a 175 MWe CE eight corner T-fired boiler constructed in the late 1950's. The Rotamix system combines the overfire air system with an aqueous ammonia SNCR (Rotamix) to reduce full load NO_x levels of 0.63 lb/MM Btu to 0.17 lb/MM Btu. This was the first installation of Rotamix in the U.S.

It is important to note that the typical shape of the NO_x versus load curve for a T-fired boiler reverses with the installation of ROFA and Rotamix. Before controls are added, NO_x increases with decreasing boiler load. After the installation of ROFA and Rotamix, NO_x decreased with lower load. Therefore the total tons of NO_x reduced on a cycling boiler like Cape Fear 6 is greater than would be expected simply considering the full load NO_x reductions.

The 19 percent aqueous ammonia for the SNCR system is injected through the ROFA air nozzles at different elevations depending on boiler load and temperature. Injecting through the air nozzles provides enhanced mixing with the combustion gases. Ammonia slip is measured at the economizer outlet using a Siemens LDS 3000 ammonia slip analyzer. Use of this analyzer allows the system to control slip to 5 ppm, saving ammonia and mitigating many problems experienced with other SNCR installations. This analyzer also measures moisture content in the flue gas stream and has provided the plant early indication of tube leaks several times.

Computer simulations using Computational Fluid Dynamics predicted improved mixing of combustion products, reduction of 90 percent in thermal NO_x formation, and reduced temperature variation in the cross-section of the upper furnace.

Unburned carbon on the fly ash increased from 3 percent to 5 percent on Unit 5 and from 11 percent to 15 percent on Unit 6. It appears the proportion of fly ash to bottom ash has decreased as well and further testing is needed to quantify these results.

Installed cost of the ROFA system is \$25 to \$30/kW and \$300/ton NO_x removed. The Rotamix installed costs about \$35 to \$40/kW and \$1,000/ton NO_x removed.

In 2002 a Rotamix system was added to the ROFA installation on Cape Fear Unit 5. Tuning was completed in April and full load NO_x levels are 0.16 lb/MM Btu.